PRICE EQUIVALENT IMPACTS OF THE DDA IN THE KOREAN RAW-MILK MARKET

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Keywords
DDA, dairy, milk, tariff, price equivalent

Abstract
This study estimates the potential impacts of the Doha Development Agenda (DDA) on the Korean raw-milk market. The DDA has not reached an agreement yet. Although there are different attitudes about several issues such as Special Safeguard Mechanism (SSM), Sensitive Products (SP), and Tariff Rate Quota (TRQ) creation, WTO member countries have reached an agreement for major issues of the modalities in the DDA. Hence, this study estimates the impacts of the DDA that will finally reach an agreement sooner or later. For estimating the impacts of the DDA, this study makes a dairy trade model for the Korean dairy industry and measures the impacts of the DDA in terms of raw-milk price for fluid use incurred by further tariff cuts in the Korean dairy market by the DDA. This study considers several scenarios because the status of Korea is not settled yet and a country can select dairy products as sensitive products, special products, or general products and a country can select different options in each category. The results of this study can be used for preparing policies for subsidizing the domestic raw-milk producers to rebalance their loss in the raw-milk market incurred by the DDA.

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1. Introduction

The DDA started in 2001 and its round of trade talks have been underway for eight years, but it failed to make an agreement between the country members of the WTO. Although the DDA failed to make a multi-consent agreement in 2008, four revised draft modalities were suggested in 2008 and most of the provisions in the modalities of the DDA, such as tiered tariff reduction formula, were agreed upon. Hence, we can make a country schedule based on the fourth revised draft modalities, which may affect the Korean agricultural markets.

It is very important to review and apply all the terms in the revised draft of the modalities to the Korean agricultural market and prepare a proposal for domestic policies for the future when an agreement will be reached in the DDA. This study focuses on the impacts of the DDA on the domestic dairy market. The tariff rates for several dairy products are high and the quantity of imported dairy products is large, making the Korean dairy market one of the most important industries to be analyzed.

The Korean dairy market consists of two markets: fluid-milk market and processed-milk market. The modalities of the DDA will open both markets; however, fluid-milk products are not easy to import because fluid-milk products turn sour more easily than processed-milk products. Hence, the consequences of the DDA will affect mostly the domestic processed-milk market. The degree of the impacts of the DDA will depend on the size of tariff cuts on imported processed-milk products.

The tariff cuts on imported processed-milk products are decided by the status of Korea in the DDA; however, Korea doesn't have the final say in determining its country status in the DDA. It can claim to be a developing country but other WTO member countries, such as the agricultural products exporting countries of Australia, New Zealand, and Brazil, may not agree to the claim on Korea's status. Therefore, this study considers several scenarios for the status of Korea in the DDA. Korea can be considered as a developing country or a developed country. In addition, the country has to choose dairy products as general or sensitive products or (only for a developing country) special products.

Many studies analyze the impacts of agricultural trade policy on domestic markets with empirical simulations. For example, recent studies dealing with dairy trade in domestic markets include Bouamra-Mechemache et al.

(2002), OECD (2004), and Alston et al. (2006). For the Korean dairy market, Song and Sumner (1999), Lee, Sumner and Ahn (2006), Kim and Chang (2008) consider lower trade barriers in the Korean dairy industry.

Song and Sumner (1999) find that the Korean dairy market has been growing with economic development and there is the potential of substantial growth of imported processed-dairy products by further opening. However, they also indicate that the domestic fluid-milk market will be reserved for domestic raw-milk producers despite further opening of the dairy market. Lee, Sumner, and Ahn (2006) consider several scenarios to see the impacts of further opening of the domestic dairy market to the international market. The trade model of Lee, Sumner, and Ahn (2006) only considers that the raw-milk price for processed use responds to the tariff cuts for imported dairy products and they fix the raw-milk price for fluid use. However, there is much potential that the domestic producer groups will require an increase of raw-milk price for fluid use to rebalance their expected loss incurred by increased imports of processed-milk products. Or the government may subsidize the loss of producers' surplus incurred by the DDA in the raw-milk market.

Kim and Chang (2008) analyze the impact of the KORUS FTA on the domestic cheese and butter markets. Their analysis is limited to two dairy products and does not consider the impacts of the KORUS FTA on domestic raw-milk producers. However, this study connects the impacts of the DDA to the raw-milk price received by domestic raw-milk producers.

This study focuses on measuring the DDA impacts in terms of raw-milk price for fluid use in the raw-milk market. When the Korean dairy market is opened with lower tariffs following the modalities of the DDA, domestic raw-milk producers will be worse off. Under the current raw-milk pricing system, the government can subsidize raw-milk producers by raising the raw-milk price for fluid use. This study estimates the impacts of the DDA in terms of price equivalent of the raw-milk price for fluid use. The results of this study will be useful for policy makers to set up a plan to subsidize domestic raw-milk producers.

2. Model

This study develops a Korean dairy trade model that focuses on calculating the impacts of the DDA on the raw-milk price received by domestic raw-milk producers. An equilibrium displacement model is developed for the Korean dairy trade model. To avoid an aggregation bias problem, this study uses dairy components (fat and non-fat-solid) rather than each dairy product.

Equation (1) determines the prices for dairy components (fat and nfs) received by domestic raw-milk producers.

$$P_j^f = 0.5 * (1 + t_j) * P_j^{\text{int}}, \quad j = \text{fat, nfs,}[1] \tag{1}$$

where t_j is a tariff rate for dairy component j and P_j^{int} is an international price for dairy component j. Equation (2) shows how the raw-milk price for processed use (P_{pro}^f) can be calculated from the prices of the two components.

$$P_{pro}^f = (\mu_{fat} * P_{fat}^f) + (\mu_{nfs} * P_{nfs}^f), \tag{2}$$

where μ_{fat} and μ_{nfs} are component ratios in a unit of raw milk. Total raw-milk production depends on the raw-milk price for fluid use (P_{fl}^f), raw-milk price for processed use (P_{pro}^f), and the share of raw milk for fluid use (α) as below

$$mc(Q_T^f) = \alpha P_{fl}^f + (1 - \alpha) P_{pro}^f, \tag{3}$$

where $mc(Q_T^f)$ is a marginal cost for producing raw milk. The consumer price for fluid milk (P_{fl}^r) is simply derived as

$$P_{fl}^r = P_{fl}^f + c_{fl}, \tag{4}$$

[1] The value 0.5 in equation (1) is a coefficient of converting dairy prices into raw milk price for fat and nfs.

where c_{fl} is a unit processing and marketing cost of fluid-milk product. Similarly, the consumer prices for dairy components are derived as

$$P_j^r = P_j^f + c_j,\ j = \text{fat,nfs}, \tag{5}$$

where c_j is a unit processing and marketing cost of dairy component *j*. The demands for fluid milk and dairy components are characterized by

$$Q_{fl}^r = D_{fl}^r(P_{fl}^r \mid z_{fl}), \tag{6}$$

where z_{fl} is a vector of demand shifting factors and

$$Q_j^r = D_j^r(P_{fat}^r, P_{nfs}^r \mid z_j),\ j = \text{ fat, nfs}, \tag{7}$$

where z_j is a vector of demand shifting factors.
Equations (8)-(11) are the market clearing conditions in the Korean dairy industry. Equation (8) equates the raw-milk production for fluid use (Q_{fl}^f) and the consumption of fluid-milk product (Q_{fl}^r). Total raw-milk production (Q_T^f) is the same as the sum of the raw-milk production for fluid use (Q_{fl}^f) and processed use (Q_{pro}^f). The domestically produced and consumed dairy component *j* ($Q_{j,d}^r$) can be obtained by multiplying the raw-milk production for processed use (Q_{pro}^f) by the component ratio (μ_j). Total consumed dairy component *j* (Q_j^r) is the sum of domestically made component *j* ($Q_{j,d}^r$) and imported component *j* (I_j).

$$Q_{fl}^f = Q_{fl}^r \tag{8}$$

$$Q_T^f = Q_{fl}^f + Q_{pro}^f \tag{9}$$

$$Q_{j,d}^r = \mu_j * Q_{pro}^f \tag{10}$$

$$Q_j^r = Q_{j,d}^r + I_j \tag{11}$$

The system of dairy trade model above can be changed into an equilibrium displacement model below. *E* is a proportional change operator, *R* stands for a ratio and S stands for a share.

$$EP^f_{fat} = E\lambda_{fat}\ , \text{ where } \ \lambda_{fat} = (1 + t_{fat}) \text{ and } E\lambda_{fat} = \frac{dt_{fat}}{(1 + t_{fat})} \tag{1$'$}$$

$$EP^f_{nfs} = E\lambda_{nfs}\ , \text{ where } \ \lambda_{nfs} = (1 + t_{nfs}) \text{ and } E\lambda_{nfs} = \frac{dt_{nfs}}{(1 + t_{nfs})} \tag{1$''$}$$

$$EP^f_{pro} = R^p_{fat} * EP^f_{fat} + (1 - R^p_{fat}) * EP^f_{nfs}\ , \text{ where } R^p_{fat} = \frac{\mu_{fat} * P^f_{fat}}{P^f_{pro}} \tag{2$'$}$$

$$\frac{1}{\theta} EQ^f_T = R^{fl}_p * EP^f_{fl} + (1 - R^{fl}_p) * EP^f_{pro}\ , \text{ where } \frac{1}{\theta} = \frac{\partial mc}{\partial Q^f_T} \frac{Q^f_T}{mc}\ , \text{ and } \tag{3$'$}$$

$$R^{fl}_p = \frac{\alpha P^f_{fl}}{\alpha P^f_{fl} + (1 - \alpha) P^f_{pro}}$$

$$EP^r_{fl} = R^{fr}_{fl} * EP^f_{fl}, \text{ where } \ \eta_{fl} = \frac{\partial Q_{fl}}{\partial P^r_{fl}} \frac{P^r_{fl}}{Q_{fl}} \text{ and } R^{fr}_{fl} = \frac{P^f_{fl}}{P^r_{fl}} \tag{4$'$}$$

$$EP^r_{fat} = R^{fr}_{fat} * EP^f_{fat}\ , \text{ where } \ \eta_{fat} = \frac{\partial Q^r_{fat}}{\partial P^r_{fat}} \frac{P^r_{fat}}{Q^r_{fat}},\ \eta_{nfs,fat} = \frac{\partial Q^r_{nfs}}{\partial P^r_{fat}} \frac{P^r_{fat}}{Q^r_{nfs}}, \tag{5$'$}$$

$$\xi_{nfs,fat} = \frac{\partial Q^r_{nfs}}{\partial q_{fat}} \frac{q_{fat}}{Q^r_{nfs}} \text{ and } R^{fr}_{fat} = \frac{P^f_{fat}}{P^r_{fat}}$$

$$EP^r_{nfs} = R^{fr}_{nfs} * EP^f_{nfs}\ , \text{ where } \ \eta_{nfs} = \frac{\partial Q^r_{nfs}}{\partial P^r_{nfs}} \frac{P^r_{nfs}}{Q^r_{nfs}}\ ,\ \eta_{fat,nfs} = \frac{\partial Q^r_{fat}}{\partial P^r_{nfs}} \frac{P^r_{nfs}}{Q^r_{fat}}\ , \tag{5$''$}$$

$$\xi_{fat,nfs} = \frac{\partial Q^r_{fat}}{\partial q_{nfs}} \frac{q_{nfs}}{Q^r_{fat}} \text{ and } R^{fr}_{nfs} = \frac{P^f_{nfs}}{P^r_{nfs}}$$

$$EQ^r_{fl} = \eta_{fl} EP^r_{fl} + \eta_{z,fl} Ez_{fl}\ , \text{ where } \eta_{fl} = \frac{\partial Q_{fl}}{\partial P^r_{fl}} \frac{P^r_{fl}}{Q_{fl}} \text{ and } \eta_{z,fl} = \frac{\partial Q^r_{fl}}{\partial z_{fl}} \frac{z_{fl}}{Q^r_{fl}} \tag{6$'$}$$

$$EQ^r_{fat} = \eta_{fat} EP^r_{fat} + \eta_{fat,nfs} EP^r_{nfs} + \eta_{z,fat} Ez_{fat}\ , \text{ where } \tag{7$'$}$$

$$\eta_{fat,nfs} = \frac{\partial Q^r_{fat}}{\partial P^r_{nfs}} \frac{P^r_{nfs}}{Q^r_{fat}} \text{ and } \eta_{z,fat} = \frac{\partial Q^r_{fat}}{\partial z_{fat}} \frac{z_{fat}}{Q^r_{fat}}$$

$$EQ^r_{nfs} = \eta_{nfs} EP^r_{nfs} + \eta_{nfs,fat} EP^r_{fat} + \eta_{z,nfs} Ez_{nfs} \text{ , where} \tag{7)''}$$

$$\eta_{nfs,fat} = \frac{\partial Q^r_{nfs}}{\partial P^r_{fat}} \frac{P^r_{fat}}{Q^r_{nfs}} \quad \text{and} \quad \eta_{z,nfs} = \frac{\partial Q^r_{nfs}}{\partial z_{nfs}} \frac{z_{nfs}}{Q^r_{nfs}}$$

$$EQ^f_{fl} = EQ^r_{fl} \tag{8)'}$$

$$EQ^f_T = S^{pT} EQ^f_{pro} + (1 - S^{pT}) EQ^f_{fl} \text{ , where } S^{pT} = \frac{Q^f_{pro}}{Q^f_T} \tag{9)'}$$

$$EQ^r_{fat,d} = EQ^f_{pro} \tag{10)'}$$

$$EQ^r_{nfs,d} = EQ^f_{pro} \tag{10)''}$$

$$EQ^r_{fat} = S^f_{fat} EQ^r_{fat,d} + (1 - S^f_{fat}) EI_{fat} \text{ , where } S^f_{fat} = \frac{Q^r_{fat,d}}{Q^r_{fat}} \tag{11)'}$$

$$EQ^r_{nfs} = S^f_{nfs} EQ^r_{nfs,d} + (1 - S^f_{nfs}) EI_{nfs} \text{ , where } S^f_{nfs} = \frac{Q^r_{nfs,d}}{Q^r_{nfs}} \tag{11)''}$$

3. Calibration

For the simulations, we need information about the elasticities, ratios, and shares as well as the tariff cuts proposed by the modalities of the DDA. This study reviews the previous studies for the values of the elasticities and chooses a reasonable number for each parameter, and calculates the values for ratios and shares from the available industry data of year 2007. Tariff schedules for various processed-milk products under the WTO agreement are shown in table 1. The parameters used in the simulations are summarized in table 2.

Several studies estimate the price elasticity of demand for fluid milk and processed-milk products in the Korean market. For fluid milk, Baeck and Lee (2002) estimate a range of -0.33 to -0.68. For processed-milk products, this study refers to the estimates of the price elasticities of demand for cheese, butter, and infant formula from Lee, Sumner and Ahn (2005) and for mixed milk powder, skim milk powder, and whole milk powder from Song et al. (2005).

In the simulations, this study uses -0.5 for price elasticity of demand for fluid milk because the value -0.5 is in between -0.33 and -0.68. This study uses the following elasticities for processed milk products: cheese -0.64, butter -1.47, infant formula -1.32, mixed milk powder -0.51, skim milk powder -0.51, and whole milk powder -0.51. The price elasticities of demand for dairy components, fat and nfs, are derived from the price elasticities of demand for processed-milk products using the formula developed in Alston et al. (2006).[2] The coefficients used in the simulation are $\begin{bmatrix} \eta_{fat} & \eta_{fat,nfs} \\ \eta_{nfs,fat} & \eta_{nfs} \end{bmatrix} = \begin{bmatrix} -0.434 & -0.188 \\ -0.082 & -0.421 \end{bmatrix}$.
For the price elasticity of raw-milk supply (θ), this paper uses 0.8. Song and Sumner (1999) use 1.0 for the price elasticity of supply of raw milk. This paper uses a slightly smaller value because the producers' response to price might be inelastic under quota system.

TABLE 1. Tariff schedules for selected year and imports of dairy products to Korea in 2007

Product	Single tariff		Two-tier tariff: Tariff within MMA	Two-tier tariff: Tariff over MMA		Minimum Market Access (MMA)		Imports (2007)	
	1995	2004	2004	1995	2004	1995	2004	Value	Quantity
	%	%	%	%	%	Tons	Tons	1,000 USD	Tons
Milk	46.3	36						0	0
Whey			20	94.1	49.5	23,000	54,233	67,083	46,792
Lactose			20	94.1	49.5	15,000	9,400	31,008	13,857
Butter			40	98	89	250	420	11,298	4,096
Skim milk powder			20	215.6	176	621	1,034	17,333	4,928
Whole milk powder			40	215.6	176	344	573	3,366	1,136
Condensed milk			40	98	89	78	130	524	262
Cheese	39.6	36						178,992	49,470
Mixed milk powder*	39.6	36						103,782	31,722
Manufactured Butter	8	8						49,709	21,393
Infant formula	40	36						18,683	2,251
Cream	40	36						3,840	2,588
Fermented milk	40	36						1,054	214

* Mixed milk powder was under the MMA restriction until 2000 (26,415 tons in 2000), but after 2000 it is not restricted to the MMA quota.
Source: Korea Dairy Committee

[2] The formula converts price elasticities of dairy products into price elasticities of dairy components.

TABLE 2. Data for 2007 (baseline)

Name		Unit	2007 (base year)
Cow milk production (A)		ton	2,187,824
Fluid milk consumption		ton	1,581,742
Adjusted by fermented milk (assume 25% of fluid milk)		ton	395,436
Adjusted fluid-milk consumption (B)		ton	1,977,178
Raw milk used for processed use (C=A-B)		ton	210,647
Domestic production of components	Fat	ton	8,426
	Nfs	ton	18,958
Total consumption of components	Fat	ton	65,005
	Nfs	ton	132,780
Quantity shares	$S^{pT}(=1-\alpha)$		0.0963
	S^{f}_{fat}		0.1296
	S^{f}_{nfs}		0.1428
Price ratios	R^{p}_{fat}		0.1844
	R^{fl}_{p}		0.9550
	R_{fp}		0.5331
	R^{L}_{fl}		0.4418
	R^{mc}_{fl}		0.3750
	R^{fr}_{fl}		0.3318
	R^{fr}_{fat}		0.1667
	R^{fr}_{nfs}		0.1667

Note: I assume that the ratio of fat to nfs used in fluid products is equal to the ratio of fat to nfs (0.04/0.09) in raw milk produced in Korea.

Source: Author's calculations, the ministry of agriculture and forestry in Korea for 2007.

Tariff rates for dairy components are derived by equation (12) using the shares of dairy components in each dairy product as below.

$$t_j = \frac{\left\{\sum_l t_l^L * \mu_l^j * MMA_l + \sum_l t_l^H * \mu_l^j * (M_l - MMA_l)\right\} + \left\{\sum_m t_m * \mu_m^j * M_m\right\}}{\sum_n \mu_n^j * M_n}, \quad j = \text{fat,nfs}, \qquad (12)$$

where n (=1, 2, ⋯, N)[3] indicates l (=1, 2, ..., L) (processed-milk products of which actual imports are greater than minimum market access quota) and m (=1, 2, ..., M) (processed-milk products of which imports are less than MMA quota or for which imports are not restricted by MMA quota), μ_l^j (or μ_m^j) is a component (fat or nfs) ratio in a unit of processed-milk product of l (or m), MMA_l is the MMA quota for processed-milk product l, M_n (M_l) is the actual imports of processed-milk product n (or l), t_l^L (or t_l^H) is a lower tariff rate for MMA quota (or is a higher tariff rate for above the MMA quota) of processed-milk product l, and t_m is a lower tariff rate or a single tariff rate for processed-milk products m which is not restricted by MMA quota. Following equation (12), tariff rates for fat and nfs for 2007 are calculated as 29.6% and 34.1% respectively.

This paper considers five scenarios that are based on the fourth revised modalities of the DDA that was issued on the sixth of December, 2008. The first three scenarios assume that Korea sustains the status of developing country and the second two scenarios assume that Korea is considered as a developed country by the WTO member countries. Table 3 shows the tiered formula for tariff reduction rates of the fourth revised modalities of the DDA for a developing country and a developed country. Based on this formula, table 4 shows the tariff rates and tariff reduction rates for dairy components fat and non-fat-solid in each scenario.

TABLE 3. Tiered formula for tariff reduction rates

Developed country		Developing country	
Final bound tariffs	Reduction rates(%)	Final bound tariffs	Reduction rates(%)
Less than 20 %	50	less than 30 %	33.3
20 %～50%	57	30%～80%	38.0
50 %～75%	64	80%～130%	42.7
more than 75 %	70	more than 130 %	46.7

[3] N is equal to the sum of L and M.

TABLE 4. Tariff rates for dairy components under the potential DDA scenarios

		Tariff rates for dairy components	
		Fat	Non-fat-solid
2007 (Baseline)		0.296	0.341
Statue of a country	Option		
Developing country	General products	0.185(37.4%)	0.230(32.6%)
	Sensitive products	0.212(28.3%)	0.254(25.6%)
	Special products	0.269(9.4%)	0.318(6.8%)
Developed country	General products	0.120(59.3%)	0.144(57.7%)
	Sensitive products	0.162(45.3%)	0.280(47.2%)

Note: 1. Numbers in parenthesis are tariff reduction rates from the baseline tariffs.
2. The options of deviation in the 4th revised modalities of the DDA ($\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{2}$ deviation) should be accompanied by increasing TRQ. This paper assumes ¼ deviation with no TRQ increase because it is hard to calculate tariff rate equivalent for TRQ increase.
3. This paper assumes 10% reductions in tariff rates for special products.

4. Simulation Results

Table 5 shows the simulation results for each scenario in terms of rate of changes of prices and quantities. All percentage changes of the endogenous variables are the impacts of the final year of the implemented DDA.

The impacts of the DDA on the Korean dairy market are smaller when Korea sustains the status of a developing country as shown in table 5. The main simulation results are as follows. When Korea sustains the status of a developing country and dairy products are selected as general products, the producer prices for fat and nfs fall by 37.4 percent and 32.6 percent respectively. Corresponding retail prices of fat and nfs fall by 6.2 percent and 5.4 percent. As a result, consumption of fat and nfs increase by 12.5 percent and imports of fat and nfs increase by 6.1 percent and 5.4 percent. The results of other four scenarios can be interpreted in a similar way.

To see the impacts of the DDA in terms of price equivalent, this study measures the changes of the raw-milk price for fluid use when we rebalance the total raw-milk production. When the Korean dairy market is opened with lower tariffs of processed products, the raw-milk price for processed use will be lower and the total domestic raw-milk production will decrease as a result. Hence, when we fix the change of total raw-milk production with zero, then we can obtain the percentage changes of raw-milk price for fluid use, which can be interpreted as a price equivalent of raw-milk price for fluid use that does not change the welfare of domestic raw-milk producers.

When we fix the change of total raw-milk production in the first scenario in table 5, i.e., producing the same amount of raw milk, we need a price increase of raw milk for fluid use by 1.6 percent (see the last row in table 5). In the second and third scenarios, dairy products are selected as sensitive products and special products respectively under an assumption of a developing country. Then, the price equivalent impact of the DDA is lowered from 1.6 percent to 1.2 percent and 0.3 percent respectively (see the last row in table 5).

When Korea is recognized as a developed country by other WTO member countries, then the price equivalent impact of the DDA in terms of raw-milk price for fluid use becomes larger from 1.6 percent to 2.7 percent in the fourth scenario and to 2.2 percent in the fifth scenario. That is, when Korea is classified as a developed country in the DDA, the welfare impacts of

TABLE 5. Simulation results of each scenario for the impacts of the DDA

	Developing country			Developed country	
	General products	Sensitive products	Special products	General products	Sensitive products
Prices					
Producer price of fat	-37.4%	-28.3%	-9.4%	-59.3%	-45.3%
Producer price of nfs	-32.6%	-25.6%	-6.8%	-57.7%	-47.2%
Retail price of fat	-6.2%	-4.7%	-1.6%	-9.9%	-7.6%
Retail price of nfs	-5.4%	-4.3%	-1.1%	-9.6%	-7.9%
Quantities					
Total production	-1.2%	-0.9%	-0.3%	-2.1%	-1.7%
EQRFL	0.0%	0.0%	0.0%	0.0%	0.0%
Domestic fat production	3.7%	2.8%	0.9%	6.1%	4.8%
Domestic nfs production	2.8%	2.2%	0.6%	4.9%	3.9%
Consumption of fat	-12.5%	-9.8%	-2.7%	-21.7%	-17.5%
Consumption of nfs	-12.5%	-9.8%	-2.7%	-21.7%	-17.5%
Imports of fat	6.1%	4.7%	1.4%	10.2%	8.1%
Imports of nfs	5.4%	4.2%	1.2%	9.3%	7.5%
Price equivalent impacts					
Raw-milk price for fluid use	1.6%	1.2%	0.3%	2.7%	2.2%

the DDA on domestic raw-milk producers becomes larger and the government should raise the raw-milk price for fluid use more to rebalance the welfare loss of domestic raw-milk producers.

5. Sensitivity Analysis

One of the key assumptions in this paper is to assume that 25 percent of fluid milk is used for fermented-milk products. In table 5, 606,082 tons of raw milk is used for processed-milk products, which is 38 percent of fluid-milk consumption. We can also make extreme assumptions on the usage of raw milk. One is to assume 606,082 tons of raw milk is used for fermented-milk products and the other is to assume zero tons of raw milk is used for fermented-milk products. In table 5, 395,436 tons of raw milk is used for fermented-milk products. When the amount of raw milk used for fermented-milk products is changed, the values of the parameters that are $R_p^{fl}, S^{pT}(=1-\alpha)$, S_{fat}^f, and S_{nfs}^f are also changed. Table 6 reports the price equivalent impacts of the DDA in terms of raw-milk price for fluid use within ranges of zero and 600,000 tons of raw milk used for fermented milk products.

First consider the case when raw milk used for fermented-milk products is zero, which means 1,581,742 tons of raw milk from 2,187,824 tons is used for fluid-milk consumption and the remaining 606,082 tons of raw milk is used for making processed-milk products except fermented-milk products. In this extreme case, the impact of the DDA in terms of raw-milk price for fluid use becomes larger than the case in table 5. Under an assumption of developing country with general products option, the price equivalent impact of the DDA in terms of raw-milk price for fluid use is 5.7 percent that is much bigger than 1.6% in table 5. Other values in table 6 can be interpreted in a similar way. For an another extreme case, consider the case when almost all of the remaining raw milk (600,000 tons in table 6) is used for fermented milk, which means almost all of the domestic raw-milk production is used for domestic fluid-milk consumption. In this case, the lower tariffs of processed-milk products do not affect the domestic dairy market as seen in the last row of table 6. The key point is that as more domestic raw-milk production is used for domestic fluid-milk consumption, the lesser the price equivalent impact of the DDA is.

TABLE 6. Price equivalent impacts of the DDA in terms of the raw-milk price for fluid use in the raw-milk market

Amount of raw milk used for fermented-milk products (tons)	Developing country			Developed country	
	General products	Sensitive products	Special products	General products	Sensitive products
0	5.7%	4.4%	1.2%	9.8%	7.9%
200,000	3.4%	2.6%	0.7%	5.8%	4.7%
400,000	1.5%	1.2%	0.3%	2.7%	2.2%
600,000	0.0%	0.0%	0.0%	0.1%	0.1%

6. Conclusion

The raw-milk pricing rule in Korea consists of two parts. One is a pricing rule for raw milk used for fluid milk and the other is a rule for raw milk used for processed use. The pricing rule for processed use is affected by imported dairy prices and tariff rates levied on imported dairy products. Hence, raw-milk price for processed use will be lowered by further tariff cuts on imported dairy products, and domestic raw-milk producers will be worse off as a result of further market opening. However, the raw-milk price for fluid use is determined by a domestic market situation.

This paper considers the impacts of the DDA on the domestic dairy market in terms of raw-milk price for fluid use. As explained, the more the domestic market opens, the worse the domestic raw-milk producers' welfare is. One of the policy options that we are considering is to raise the raw-milk price for fluid use to rebalance producers' welfare loss.

This paper considers five scenarios for the potential development of the DDA and measures the impacts of the DDA in terms of raw-milk price for fluid use. A key conclusion is that the more domestically produced raw milk is used for fluid use the less the impacts of the tariff cuts of the DDA on the domestic dairy market. As expected, the price equivalent impact of the DDA in terms of raw-milk price for fluid use is lessened when Korea sustains the developing country status in the DDA and we choose dairy products as special products (or sensitive products) rather than general products.

In a potential scenario analysis in table 5, the price equivalent of the DDA in terms of raw-milk price for fluid use ranges from 0.3 percent to 2.7 percent according to the status of Korea and its options. These measured values indicate that domestic raw-milk producers can be compensated by raising the raw-milk price for fluid use by 0.3-2.7 percent when the Korean dairy market is opened with further tariff cuts by the DDA. If domestically produced raw milk is used more for processed use, then the price equivalent impact of the DDA will be larger and the raw-milk price for fluid use should be raised further to compensate the domestic raw-milk producers' welfare loss caused by the DDA.

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